

High Arctic renewable energy: Svalbard as a showcase

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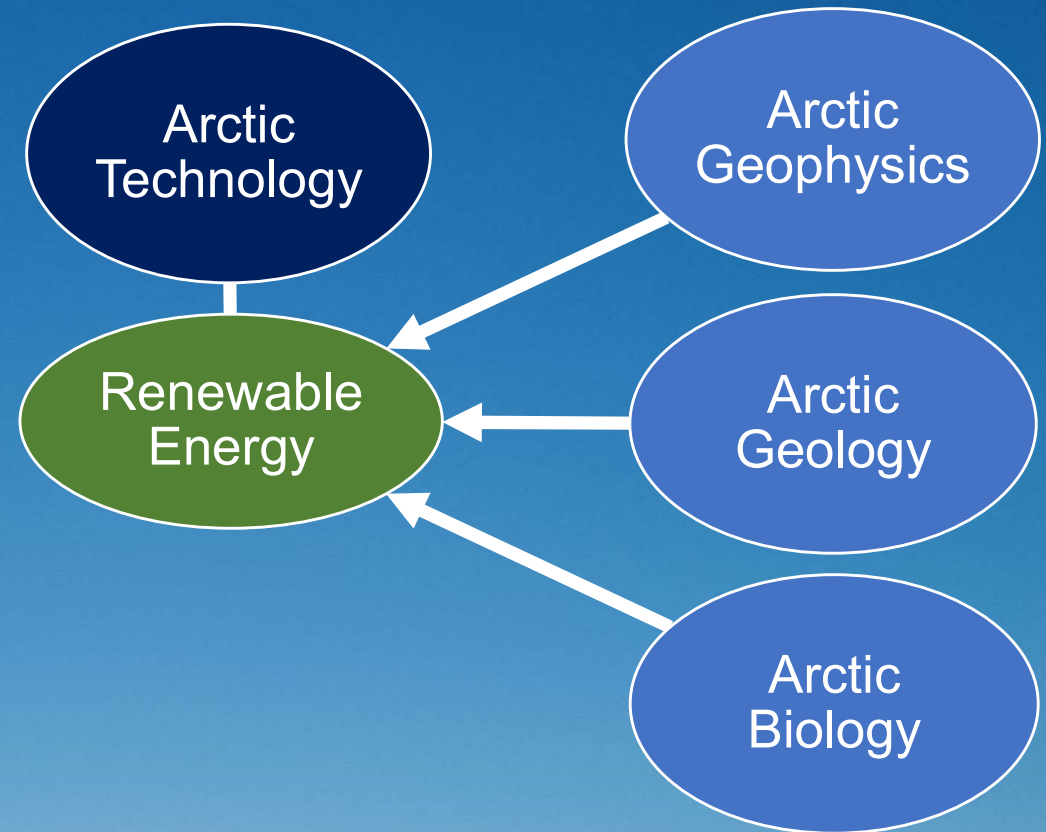
Matthias Henkies, Arthur Garreau, Jules Boulard (UNIS)
and
Mons Ole Sellevold (Store Norske Energi)



The University Centre in Svalbard (UNIS)



- Ca 60 scientific staff (including Ph.D. students)
- Ca 750 students from 45 different countries
- Year-round presence in the High Arctic



Change in Longyearbyen; From coal to renewable energy

- Coal as an energy source since 1910, ended 19 October 2023
- Now running on diesel
- Gradual transition to renewable energy
- 1,500 other Arctic off-grid societies



Why do we need research on renewable energy in the High Arctic?

- Urgent solutions needed
- Proven solutions specific for the High Arctic do not exist
- Tested elsewhere does not necessarily mean it will work in all of the Arctic
- Errors are expensive: for example, supply failure, economy and nature



What research do we need on renewable energy in the High Arctic?

- Understand the Arctic environment
- Test technology
- Adapt technology
- Implement technology

Local knowledge is the key



UNIS research focus

Wind energy

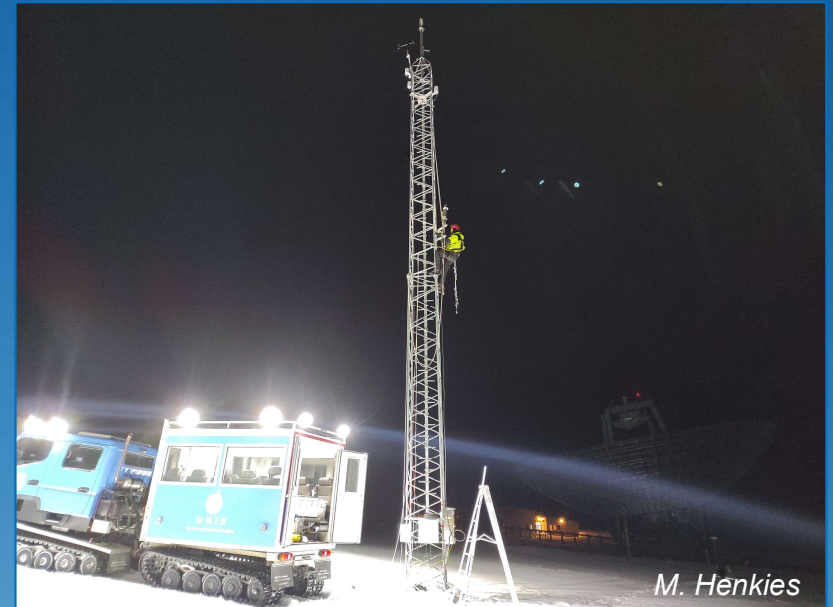
Solar energy

Geothermal energy



Specific weather for the High Arctic

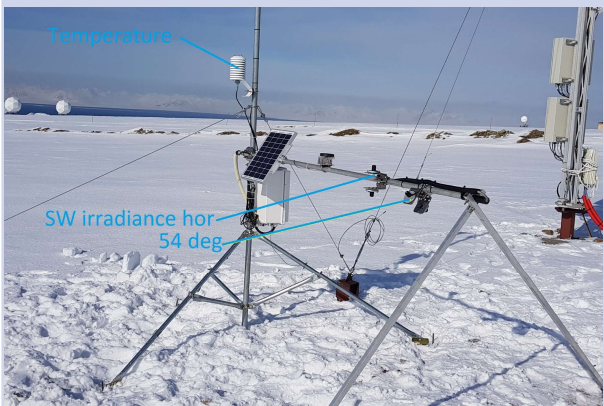


- Very local weather
- Less is known about High Arctic weather
- Long periods with polar night / midnight sun
- Snow drift / icing
- Weather models and forecasts are more uncertain than at lower latitudes



Adapting solar energy technologies for use in the Arctic



Arthur Garreau,
Ph.D. candidate

Solar irradiance evaluation	Solar PV potential assessment	Understanding and adapting solar PV for Svalbard and Arctic conditions – Isfjord Radio case
Measurements solar irradiance around Longyearbyen (Paper in preparation)	Evaluating solar PV potential in the High-Arctic setting	Tests at a larger scale to evaluate panel responses to the Arctic's severe weather, including snowdrifts, icing, and wind
 <p>Temperature</p> <p>SW irradiance hor 54 deg</p>		

Mapping, utilization and forecasting of renewable energy in the Arctic

Weather stations



Credit: Matthias Henkies

Copernicus Arctic
Regional Reanalysis

**Paper 1:
Mapping
Renewable
Energy
Potential**

ipcc
INTERGOVERNMENTAL PANEL ON
climate change

Climate
models

Different
emission
scenarios

**Paper 2:
Future evolution of
Arctic's renewable
energy potential**



Jules Boulard
PhD Candidate

Webcam or sky camera



Credit: Borealis Panorama 360

Cloud observations

Weather stations

High
frequency
variability
of solar
radiation

AI model

**Paper 3:
Very short-term
solar energy
forecasting**

Wind climate of High Arctic complex terrain applied to renewable energy



Matthias Henkies

PhD candidate in:

Wind Climate



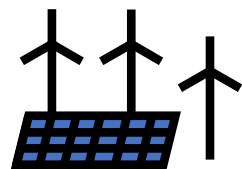
of High-Arctic

Complex Terrain



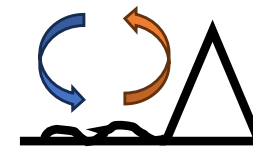
Applied to

Renewable Energy



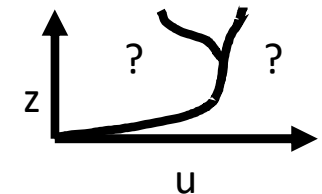
Current research topics:

- Thermally-driven winds

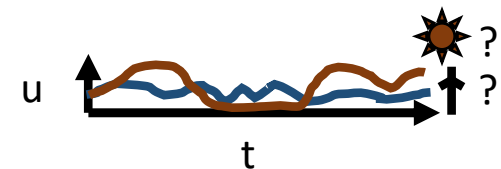


Henkies et al. 2023:
The Arctic Fjord Breeze
...
(Bound. Layer Met.)

- Wind profiles



- Low-wind periods



- Snowdrift





World's northernmost ground mounted PV park Isfjord Radio, Svalbard

- 6 rows, 10 m spacing, south facing, 45° tilt
- Installed capacity: 198 kWp (360 panels x 550 Wp)
- Annual production: 168 000 kWh (849 kWh/kWp)
- Construction: 2023
- Owner and operator: Store Norske Energi AS



Photo: A. Garreau, UNIS



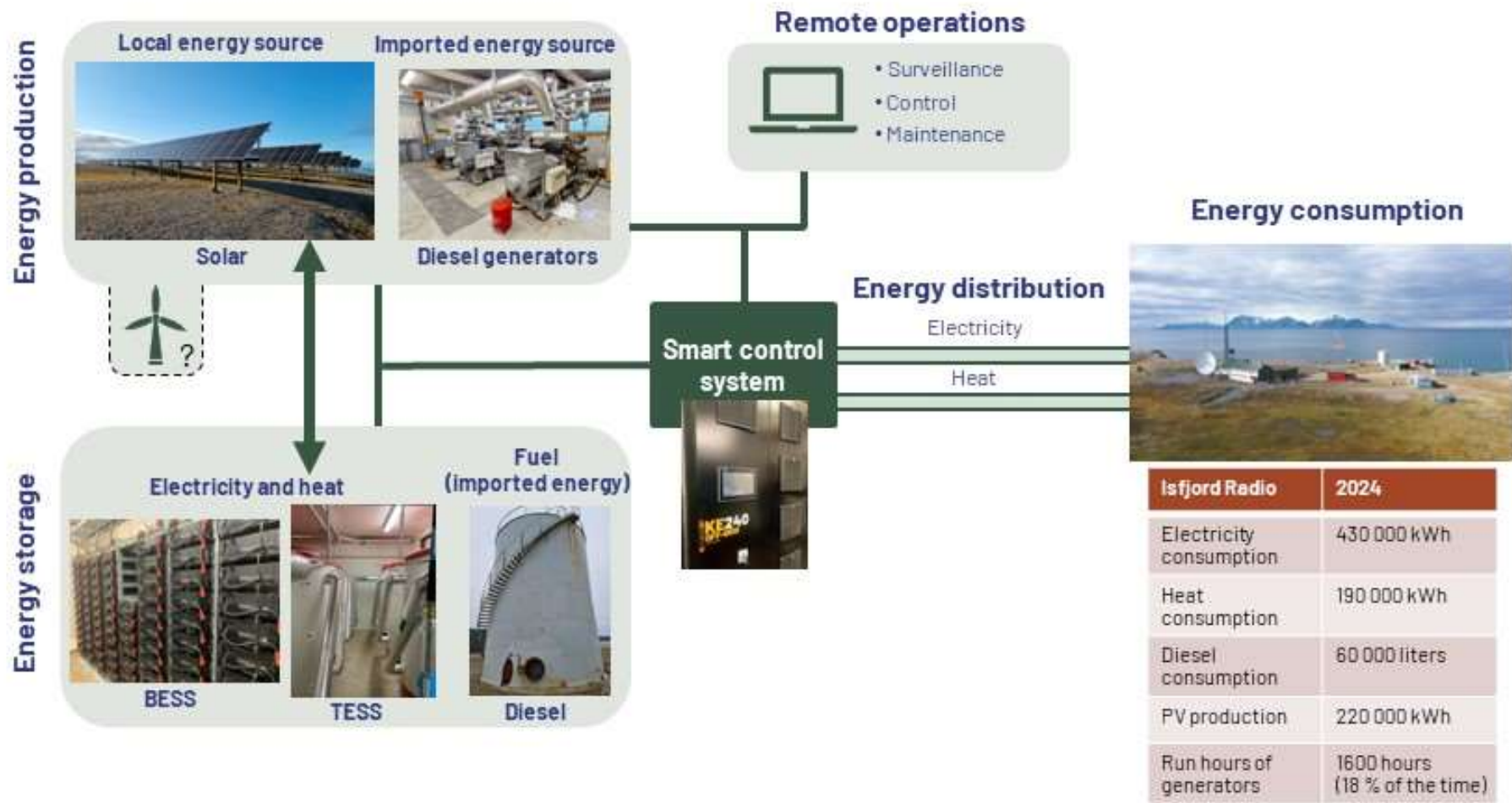
Photo: M. O. Sellevold, Store Norske Energi



Photo: M. O. Sellevold, Store Norske Energi

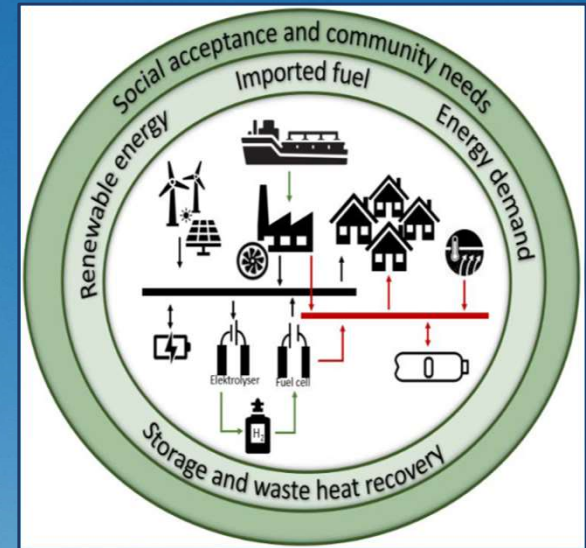


Off-grid hybrid energy system at Isfjord Radio, Svalbard



Zero Emission Energy Systems for the Arctic (ZEESA) 2023-2026, RCN + Industry, Ca 20 MNOK

- Thermal-electric integrated energy systems
- Combining meteorological models with field studies
- Investment and design analysis
- Norwegian industry players



<https://www.sintef.no/en/projects/2023/zeesa-zero-emission-energy-systems-for-the-arctic/>



Future plans of UNIS

- Arctic energy research and test centre
- Co-operation with industry: If solutions work in Svalbard, they can be exported to the whole Arctic, “Tested in Svalbard”
- New courses in cold climate renewable energy (M.Sc. and Ph.D.) from autumn 2024
 - AE-341: Sustainable Arctic Energy Exploration and Development
 - AE-342: Arctic Energy Meteorology
 - AE-343: Arctic Renewable Energy Infrastructure: Construction and Operation



*Svalbard as a showcase for
renewable energy and a
sustainable society*

Norwegian Prime Minister Jonas Gahr Støre (2023):

“The first pillar of Norway’s Arctic policy is the green transition, absolutely key. I see this as an opportunity, a game changer, we are moving from the age of petroleum production to renewable energy production. A lot of that will happen in the north”

